I. Calibration Procedure for **A15**:

Note: This current transformer is used only for heavy ions (gold, silicon, iron, etc.) and polarized protons. See section II on calibration procedure for the F15 transformer, which is used during HEP. Make sure that A15 is selected as the transformer of choice on the generic transformer pet page, device BIX.XF_SELCTN, column C2.

1. Computer control:
   a. Go to A10 House (if necessary). Locate the instrumentation as seen in Figure 1 in Rack 5406. Make sure all of the controls on the modules are in ‘computer’ mode. The instrumentation normally runs in ‘computer’ mode and should already be in this mode; if it seems as if pet cannot control the calibration pulse, then it should be checked.

Figure 1 – Instrumentation at A10 House

2. The calibration takes place in Building 911B, Room 222 (above the MCR). The signal can be observed at connector RK73AG01 (the signal direct from the A10 House, by first connecting it through the buffer at RK73A-E08), or at any of the electronics test points. The scope can be triggered by RK73J09 (AGS CBM). With the beam present, the following profile on the next page should be expected (with two transfers from Booster). Also connect RK73U05 (AGS CBM V/F output) to the scalar at the lower right to display the reading.

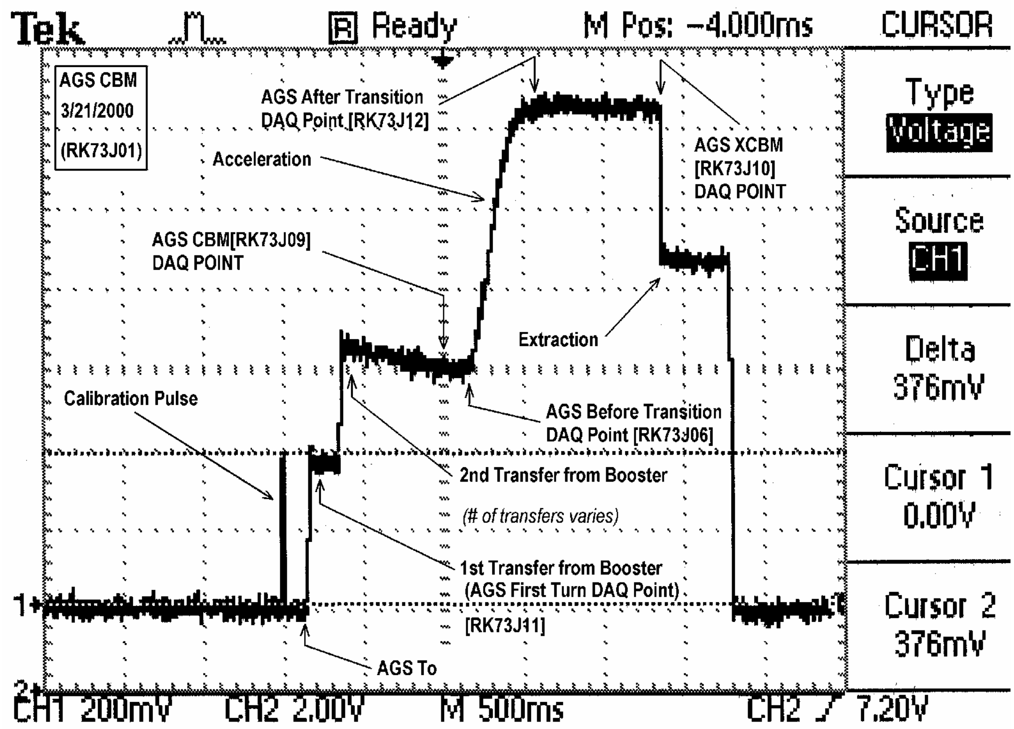

Figure 2 – Sample of AGS Transformer Response

3. The above signal is measured at five different time locations, using the same number of timing trigger pulses. So, to measure the calibration pulse value, one of these measuring points should be made so that it coincides with the time occurrence of the calibration pulse. The method is to move one of the data acquisition timing points onto the calibration pulse.
   a. To achieve this, shift the calibration pulse forward to t_0, event 20 (it is normally setup to occur before t_0 at AGS pre-pulse event 29). This can be done by going to the page: *Ags/Location/A10_House/CDC.A10.V102_1/* as shown in Figure 3.
   b. Once at this page, go to the CLD device *A15.CT_CALTRG.ST.C* and open the CLD window. Figure 4 shows the CLD window. Change the Index 2 value from 29 to 20. This will move the calibration pulse to t_0. Then, click ‘Send Setpoints’ to refresh the CLD with the new value.
   c. Also, make sure that device *A15.CT_CALTRG.ST* is turned ‘ON’ in column C1. This will turn the calibration pulse on.

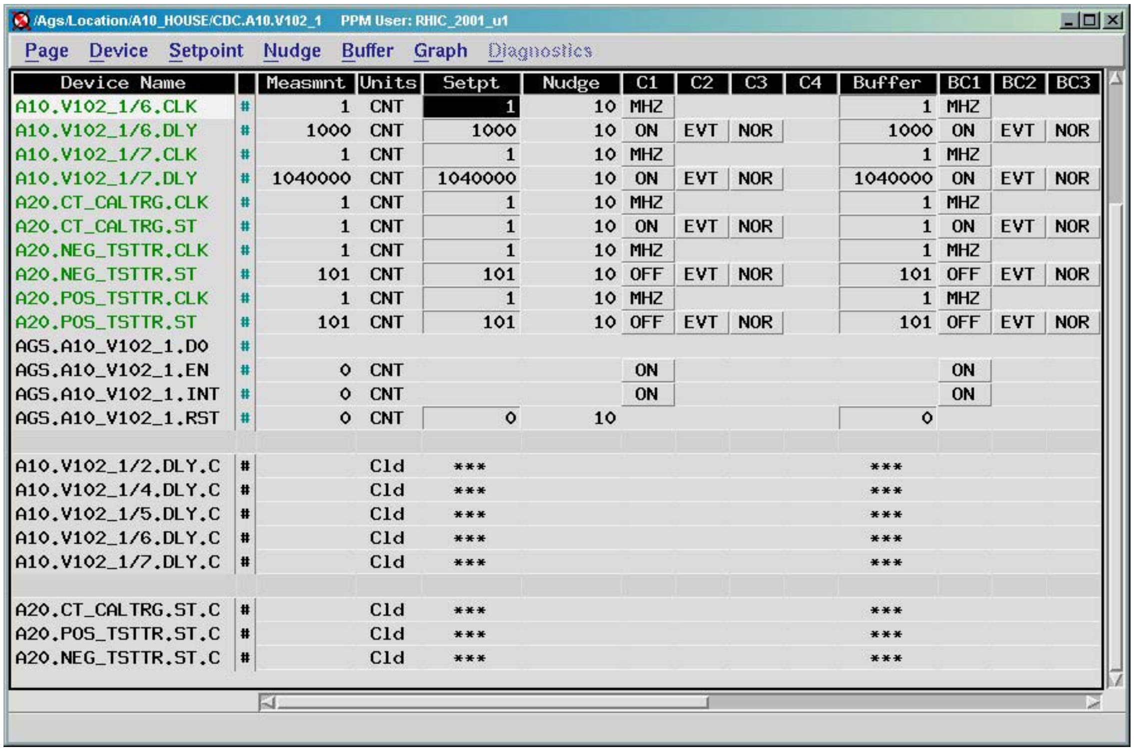

Figure 3 – pet Page with Calibration Pulse Control and CLD

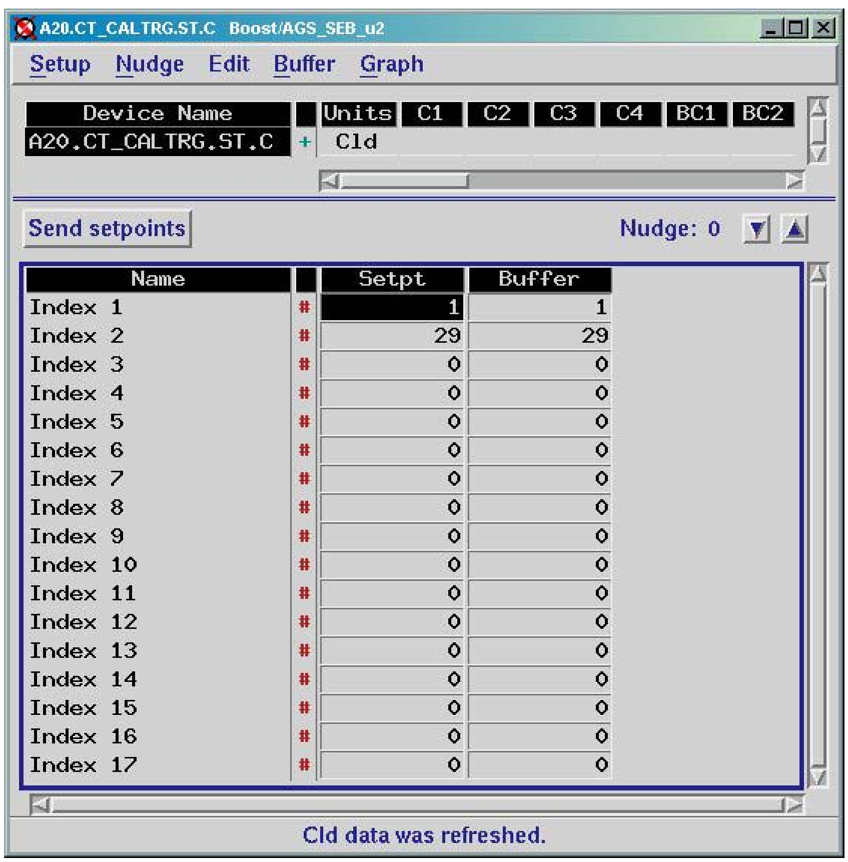

Figure 4 – CLD Window to Shift Calibration Pulse to t_0

4. With the AGS signal on the scope and the AGS CBM Timing pulse connected to the scope as a trigger, the AGS CBM timing pulse must now be moved so that the trigger for the CBM V/F will occur during the calibration pulse. Connect predat 4 in Rack 72 to the AGS CBM timing by removing the connection coming from RK73AL07. A setting of 000 on the predat will correspond to t_0. By observing the AGS signal, adjust the predat delay to place the trigger in the center of the calibration pulse. Usually, this will be at a predat setting of about 10.
5. Use the following equation to calculate the expected number of ions: I/qnf where I=calibration pulse current, q=1.6x10-19, n=charge (1 for protons, 77 for gold, 14 for silicon and 26 for iron) and f=revolution frequency (348kHz for polarized protons, 156.3kHz for gold, 155.709kHz for silicon, and 155.324kHz for iron). The calculated value should be the number displayed on the scalars.
   a. The correct scalar number will depend on the amount of the calibration current, which is controllable through pet. At the following page, two devices control the amount of current: *Ags/Location/A10_House/CDC.A10.DIGIO/*. An alternate page that the devices can be found at is *Ags/Instrumentation/Current_xfmrs/current_Xfmr*. The following table shows how the current is selected.

AMX.PROTON_TYPE	AMX.XF_GAIN	Calibration Pulse
PRO	X	50mA
PPR	LOW	5mA
PPR	HIG	500uA

Note: AMX.PROTON_TYPE should always be set to PPR for heavy ion runs.

   b. Adjust the gain on the generic current transformer pet page using the device AIX.XF_AGS.GAIN until the appropriate scalar value is being read. A gain setting of 0 corresponds to x0 gain; a setting of 255 corresponds to gain x10.

Note: The decimal point on the scalar display should read x10^9 for gold, NSRL iron, titanium, and carbon, x10^{10} for iron and silicon, x10^{11} for polarized protons.

8. Once the calibration is satisfactory, all pet values can be returned to their original setpoints and cable connections returned to their original locations.

II. Calibration Procedure for **F15**:

1. F15 is used only for high intensity protons. For all other modes, see section I regarding the A15 transformer.
2. The F15 calibration pulse is normally triggered by AGS pre-pulse. To perform the calibration, it is necessary to move the trigger to t_0. To do this, remove the connection at RK70AF06 and connect the cable from RK70AG11 to this point instead. There are no pet controls for this calibration pulse.

3. The transformer signal can be viewed from RK73K01 (the signal direct from the transformer, by connecting that signal to the buffer amp at RK73A-E08) or at one of the test points from the electronics. The scope should be triggered by AGS CBM located at RK73J09.
4. Connect RK73U05 (the AGS CBM V/F output) to the scalar at the lower right, if it is not already connected to display the scalar readout.
5. Since the calibration pulse also operates as a reset pulse, the voltage levels on either side of the calibration pulse will be different. Also since the V/F reads a value from ground and not from a voltage offset, the offset needs to be measured first before continuing onto calibration.
   a. Connect predat 4 to the AGS CBM timing at RK73J09 (remove the connection that is coming from RK73AL07). Remove the connection at the top of the 'box' at RK73K03. Connect predat 3 to either terminal on the box at RK73K03. This is done to trigger the calibration pulse at some time after t_0 so the offset before the calibration pulse can be measured.
   b. If you are on a small enough voltage scale, you will see that the offset looks sinusoidal. Generally the difference between the high and low points is about 40 counts.
   c. To measure the high point, set predat 3 to approximately 10 and predat 4 to 0. The trigger should be occurring on a high point and if it isn't, predat 4 can be adjusted accordingly. Record the scalar reading.
   d. To measure the low point, set predat 3 to 15 and predat 4 to 10. The trigger should occur on a low point of the offset voltage waveform. If it isn't occurring at the low point, adjust predat 4 accordingly. Record the scalar reading.
   e. Take an average of the two values measured in c & d and use this as the offset count value.
6. Remove the connection from predat 3 to the box and reconnect the signal from RK73I07 to the box at RK73K03. Give the system a couple of cycles to settle as when the transformer does not receive a reset pulse, the offset will drift upward.
7. Use predat 4 to adjust the CBM trigger so that it occurs in the center of the calibration pulse. Start with predat 4 set to 10 and adjust accordingly.
8. For HEP, the calibration pulse should be equivalent to 1.778×10^{13} ions. Therefore add the average offset value measured in section II, part 5e to this number to get the necessary value that the scalar should be reading.

   Note: The decimal point on the scalar should be read as $x10^{13}$. It is important to confirm this as you can add numbers with different decimal bases if the decimal point is not set to that value.

   Example:

   a. First the high point offset was measured to be 0.221 and the low point was then measured as 0.180
   b. This results in an offset average of 0.200 with the decimal point equivalent to $x10^{13}$.
   c. As the calibration pulse should be 1.778×10^{13}, adding these two values together produce a necessary scalar value of 1.978×10^{13}.

   d. Therefore, the channel should be calibrated to read 1.978.

9. Adjust the gain as necessary from the current transformer pet page using the device AIX.XF_AGS.GAIN. A gain setting of 0 corresponds to x0 gain; a setting of 255 corresponds to a gain of x10.
10. Once the channel has been properly calibrated, all cable connections returned to their original connections.